Abbas Askar

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Professional Appointments & Experience

Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences — **Warsaw (Poland)**
POLONEZ and Marie Skłodowska-Curie Fellow — *Sep 2023–Present*

Lund Observatory (from 2023: Division of Astrophysics, Department of Physics) Lund University (Sweden)
Postdoctoral Researcher — *June 2020–Aug 2023*

Lund Observatory, Department of Astronomy and Theoretical Physics — **Lund University (Sweden)**
Carl Trygger Postdoctoral Fellow (2018-2020) — *June 2018–May 2020*

Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences — **Warsaw (Poland)**
Graduate Student/Research Assistant — *Nov 2013–May 2018*

Education

Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences, Warsaw (Poland)
- ***PhD in Astronomy (with distinction)*** — *Nov 2013–May 2018*

Thesis: "Investigation of Black Hole Populations in Dense Stellar Systems using MOCCA code for Star Cluster Simulations"
Supervisor: Prof Mirek Giersz

University of Innsbruck (Austria), University of Padova (Italy) & University of Belgrade (Serbia)
- ***Master of Science in Astronomy & Astrophysics*** — *Oct 2010–Sep 2012*

Astromundus: Erasmus Mundus Joint Masters Degree
Master Thesis: *"Optical Counterparts of Ultraluminous X-ray Sources"*
Supervisor: Dr. Luca Zampieri (INAF - Padova)

University College Utrecht, Utrecht University (The Netherlands)
- ***Bachelor of Science (Hons) and Bachelor of Arts (Hons) in Liberal Arts & Sciences*** *Aug 2006–July 2009*

Double Major in Physical Sciences (Physics & Mathematics) and Humanities (Philosophy & Religious Studies)
Bachelor Thesis (Science): *"Peculiar Features in the Onsets of Thermonuclear Flashes on Neutron Stars"*
Supervisor: Dr. Jean in't Zand (HEA, SRON Netherlands Institute for Space Research)
Bachelor Thesis (Humanities): *"The Problem of Redemptive Truth: From Nietzsche to a Post-Metaphysical Culture"*
Supervisor: Dr. Floris van der Burg (University College Utrecht, Utrecht University)

Publications in peer-reviewed scientific journals and book chapters

A complete list of all publications can be found at the NASA ADS service or ORCID Page or Google Scholar Page

1. M. Giersz, **A. Askar**, A. Hypki, J. Hong, G. Wiktorowicz, and L. Hellström: *Multiple stellar populations in MOCCA globular cluster models: Transient spatial over-concentration of pristine red giant stars driven by strong dynamical encounters* (Accepted for publication in A&A Letters 2025). [ADS Link]
2. A. Bissekenov, X. Pang, A. Kamlah, M. B. N. Kouwenhoven, R. Spurzer, B. Shukirgaliyev, M. Giersz, **A. Askar**, and P. Berczik: *Evolution of star clusters with initial bulk rotation via N-body simulations* (Accepted for publication in A&A 2025). [ADS Link]
3. M. Giersz, **A. Askar**, A. Hypki, J. Hong, G. Wiktorowicz, and L. Hellström: *MOCCA-III: Effects of pristine gas accretion and cluster migration on globular cluster evolution, global parameters and multiple stellar populations* (Accepted for publication in A&A 2025). [ADS Link]
4. Li E. K., Liu S., Torres-Orjuela A., Chen X., Inayoshi K., Wang L., Hu Y. M., Amaro-Seoane P., **Askar A.**, Bambi C., and 43 co-authors: *Gravitational Wave Astronomy With TianQin.* Reports on Progress in Physics, Volume 88, Issue 5, id.056901, 54 pp. (2025). [ADS Link]
5. G. Wiktorowicz, M. Giersz, **A. Askar**, A. Hypki, and L. Hellström: *Ultraluminous X-ray sources in Globular Clusters A&A*, Vol. 696, id.A90, 14 pp. (2025). [ADS Link]
6. A. Hypki, E. Vesperini, M. Giersz, J. Hong, **A. Askar**, M. Otulakowska-Hypka, L. Hellstrom, G. Wiktorowicz: *MOCCA: Global properties of tidally filling and underfilling globular star clusters with multiple stellar populations.*

A&A, Vol. 693, id.A41, 12 pp. (2025). [ADS Link]
7. A. R Livernois; F I Aros, E Vesperini, **A Askar**, A Bellini, M Giersz, J Hong, A Hypki, M Libralato, and T Ziliotto: *Energy equipartition in multiple-population globular clusters. MNRAS*, Vol. 534, Issue 3, pp.2397-2409 (2024) [ADS Link]
8. L. Hellström, M. Giersz, A Hypki, D. Belloni, **A. Askar**, and G. Wiktorowicz : *Double white dwarf binary population in MOCCA star clusters: Comparisons with observations of close and wide binaries. Astronomy & Astrophysics* Vol. 690, id.A112, 13 pp. (2024). [ADS Link]
9. B. Bhat, B. Lanzoni, E. Vesperini, F. R. Ferraro, F. I. Aros, **A. Askar**, and A. Hypki: *New Parameters for Star Cluster Dynamics: The Role of Clusters' Initial Conditions. ApJ*, Vol. 968, Issue 1, id.2, 11 pp (2024). [ADS Link]
10. **A. Askar**, V.F. Baldassare and M. Mezcua: *Intermediate-Mass Black Holes in Star Clusters and Dwarf Galaxies.* Chapter 2 in the book, *"Black Holes in the Era of Gravitational Wave Astronomy"*, ed. Arca Sedda, Bortolas, Spera, pub. Elsevier. (June 2024) DOI: 10.1016/b978-0-32-395636-9.00010-4, Part of ISBN: 9780323956369 [ADS Link]
11. M. Pasquato, P. Trevisan, **A. Askar**, P. Lemos, G. Carenini, M. Mapelli and Y. Hezaveh: *Interpretable machine learning for finding intermediate-mass black holes. ApJ*, Vol. 965, Issue 1, id.89, 15 pp (2024). [ADS Link]
12. P. Amaro-Seoane, J. Andrews, M. Arca Sedda, **A. Askar** and 154 co-authors: *Astrophysics with the Laser Interferometer Space Antenna. Living Reviews in Relativity*, Volume 26, Issue 1, article id.2 (2023). [ADS Link]
13. A. Leveque, M. Giersz, **A. Askar** and M. Arca-Sedda: *MOCCA-Survey Database: Extra Galactic Globular Clusters. III. The population of black holes in Milky Way and Andromeda - like galaxies MNRAS*, Vol. 514, Issue 4, pp.5751-5766 (2023) [ADS Link]
14. L. Hellström **A. Askar**, A. Trani, M. Giersz, R. Church and J. Samsing: *Influence of tidal dissipation on outcomes of binary-single encounters between stars and black holes in stellar clusters. MNRAS*, Vol. 517, Issue 2, pp.1695-1708 (2022). [ADS Link]
15. A. Hypki, M. Giersz, J. Hong, A. Leveque, **A. Askar**, D. Belloni and M. Otulakowska-Hypka: *MOCCA: Dynamics and evolution of binary stars of multiple stellar populations in tidally filling and underfilling globular star clusters. MNRAS*, Vol. 517, Issue 4, pp.4768-4787 (2022). [ADS Link]
16. N. Singh, T. Bulik, K. Belczynski and **A. Askar**: *Exploring compact binary populations with the Einstein Telescope. Astronomy & Astrophysics* Vol. 667, id.A2, 15 pp. (2022). [ADS Link]
17. K. Maliszewski, M. Giersz, Mirek, D. Gondek-Rosińska, **A. Askar** and A. Hypki: *MOCCA-SURVEY Database II – Properties of Intermediate Mass Black Holes escaping from star clusters. MNRAS*, Vol. 514, Issue 4, pp.5879-5889 (2022). [ADS Link]
18. A. Leveque, M. Giersz, M. Arca-Sedda, **A. Askar**: *MOCCA-survey data base: extra galactic globular clusters - II. Milky Way and Andromeda. MNRAS*, Vol. 514, Issue 4, pp.5751-5766 (2022). [ADS Link]
19. **A. Askar**, M. B. Davies and R. P. Church: *Formation of supermassive black holes in galactic nuclei II: retention and growth of seed intermediate-mass black holes. MNRAS*, Vol. 511, Issue 2, pp.2631-2647 (2022). [ADS Link]
20. A. Kamlah, A. Leveque, R. Spurzem, M. Arca Sedda, **A. Askar**, S. Banerjee, P. Berczik, M. Giersz, J. Hurley, D. Belloni, L. Kühmichel and L. Wang: *Preparing the next gravitational million-body simulations: Evolution of single and binary stars in Nbody6++GPU, MOCCA and McLuster MNRAS*, Vol. 511, Issue 3, pp.4060-4089 (2022). [ADS Link]
21. F. Aros, A. C. Sippel, A. Mastrobuono-Battisti, P. Bianchini, **A. Askar** and G. van de Ven: *Using Binaries in Globular Clusters to Catch Sight of Intermediate-Mass Black Holes. MNRAS*, Vol. 508, Issue 3, pp.4385-4398 (2021). [ADS Link]
22. **A. Askar**, M. B. Davies and R. P. Church: *Formation of super-massive black holes in galactic nuclei I: delivering seed intermediate-mass black holes in massive stellar clusters. MNRAS*, Vol. 502, Issue 2, pp.2682-2700 (2021). [ADS Link]
23. F. Aros, A. C. Sippel, A. Mastrobuono-Battisti, **A. Askar**, P. Bianchini and G. van de Ven: *Dynamical modelling of globular clusters: challenges for the robust determination of IMBH candidates. MNRAS*, Vol. 499, Issue 4, pp.4646-4665 (2020). [ADS Link]
24. J. Hong, **A. Askar**, M. Giersz, A. Hypki and S. Yoon: *MOCCA-SURVEY Database I: Binary black hole mergers from globular clusters with intermediate mass black holes. MNRAS*, Vol. 498, Issue 3, pp.4287-4294 (2020). [ADS Link]
25. J. Samsing, D. J D'Orazio, K. Kremer, C. L. Rodriguez and **A. Askar**: *Single-single gravitational-wave captures in globular clusters: Eccentric deci-Hertz sources observable by DECIGO and Tian-Qin. Physical Review D*, Vol. 101, Issue 12, article id.123010 (2020). [ADS Link]
26. K. Belczynski, J. Klencki, C. E. Fields, A. Olejak, E. Berti, G. Meynet, C. L Fryer, D. Holz, R. O'Shaughnessy, D. A. Brown, T. Bulik, S. Leung, K. Nomoto, P. Madau, R. Hirschi, S. Jones, S. Mondal, M. Chruslinska, P. Drozda,

D. Gerosa, Z. Doctor, M. Giersz, S. Ekstrom, C. Georgy, **A. Askar**, V. Baibhav, D. Wysocki, T. Natan, W. M. Farr, G. Wiktorowicz, Miller, M. Coleman, B. Farr and J.P Lasota: *The evolutionary roads leading to low effective spins, high black hole masses, and O1/O2 rates of LIGO/Virgo binary black holes. A&A*, Vol. 636, id.A104, 40 pp. (2020). [ADS Link]

27. B. Giesers, S. Kamann, S. Dreizler, T. Husser, **A. Askar**, F. Göttgens, J. Brinchmann, M. Latour, P. M. Weilbacher, M. Wendt and M. M. Roth: *A stellar census in globular clusters with MUSE: Binaries in NGC 3201. A&A*, Vol. 632, id.A3, 20 pp. (2019). [ADS Link]
28. M. Giersz, **A. Askar**, L. Wang, A. Hypki, A. Leveque and R. Spurzem: *MOCCA-SURVEY database I. Dissolution of tidally filling star – clusters harbouring black hole subsystems. MNRAS*, Vol. 487, Issue 2, p.2412-2423 (2019). [ADS Link]
29. A. Askar, **A. Askar**, M. Pasquato and M. Giersz,: *Finding Black Holes with Black Boxes Using Machine Learning to Identify Globular Clusters with Black Hole Subsystems. MNRAS*, Vol. 485, Issue 4, p.5345-5362 (2019). [ADS Link] and [Github Page]
30. B. Leor, V. Cardoso, S. Nissanke, T. P Sotiriou, **A. Askar**, K. Belczynski, G. Bertone, E. Bon and 194 coauthors. *Black holes, gravitational waves and fundamental physics: a roadmap Classical and Quantum Gravity* Vol. 36, 14, article id. 143001 (2019). [ADS Link]. Contributor for chapter I.5 in this **review paper**.
31. D. Belloni, M. Giersz, L.E. Rivera Sandoval, **A. Askar** and P. Ciecielag: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters – IV. cataclysmic variables – properties of bright and faint populations. MNRAS*, Vol. 483, Issue 1, p.315-331 (2019). [ADS Link]
32. J. Morawski, M. Giersz, **A. Askar**, and K. Belczynski: *MOCCA-SURVEY Database I: Assessing GW kick retention fractions for BH-BH mergers in globular clusters. MNRAS*, Vol. 481, Issue 2, p.2168-2179 (2018). [ADS Link]
33. J. Hong, E. Vesperini, **A. Askar**, M. Giersz, and M. Szkudlarek: *Binary Black Hole Mergers from Globular Clusters: the Impact of Globular Cluster Properties.. MNRAS* Vol. 480, Issue 4, p.5645-5656 (2018). [ADS Link]
34. M. Arca-Sedda, **A. Askar**, and M. Giersz: *MOCCA-SURVEY Database I. Unravelling black hole subsystems in globular clusters. MNRAS* Vol. 479, Issue 4, p.4652-4664 (2018). [ADS Link]
35. **A. Askar**, M. Arca-Sedda, and M. Giersz: *MOCCA-SURVEY Database I: Galactic Globular Clusters Harbouring a Black Hole Subsystem. MNRAS* Vol. 478, Issue 2, p.1844-1854 (2018). [ADS Link]
36. K. Belczynski, **A. Askar**, M. Arca-Sedda, M. Chruslinska, M. Donnari, M. Giersz,M. Benacquista, R. Spurzem, D. Jin, G. Wiktorowicz and D. Belloni: *The origin of the first neutron star – neutron star merger. A&A*, Vol. 615, id.A91, 13 pp (2018). [ADS Link]
37. **A. Askar**, M. Giersz, W. Pych and E. Dalessandro: *COCOA code for creating mock observations of star cluster models. MNRAS* Vol 475, Issue 3, p.4170-4185 (2017). [ADS Link] and [Github Page]
38. J. Samsing, **A. Askar** and M. Giersz: *MOCCA-SURVEY Database I: Eccentric Black Hole Mergers During Binary-Single Interactions In Globular Clusters. ApJ* Vol. 855, 2, article id. 124, 5 pp.(2018). [ADS Link]
39. J. Hong, R. de Grijs , **A. Askar**, P. Berczik, C. Li, L. Wang, L. Deng, M. B. N. Kouwenhoven, M. Giersz and M., R. Spurzem: *The dynamical origin of multiple populations in intermediate-age clusters in the Magellanic clouds. MNRAS* Vol 472, 1, p.67-77(2017). [ADS Link]
40. D. Belloni, **A. Askar**, M. Giersz, P. Kroupa & H.J, Rocha-Pinto: *On the initial binary population for star cluster simulations. MNRAS* Vol 471, 3, p.2812-2828 (2017). [ADS Link]
41. D.Belloni, M. Zorotvic, M. Schreiber, N.W.C Leigh, M. Giersz and **A. Askar**: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters – III. Cataclysmic variables – Implications of model assumptions. MNRAS* 2017 Vol. 468, 2, p.2429-2446 (2017). [ADS Link]
42. R.d. Vita, M. Trenti, P. Bianchini, **A. Askar**, M. Giersz and G. van de Ven: *Prospects for detection of intermediate-mass black holes in globular clusters using integrated-light spectroscopy. MNRAS* Vol. 467, 4, p.4057-4066 (2017). [ADS Link]
43. D. Belloni, M. Giersz, H.J, Rocha-Pinto, N.W.C Leigh, **A. Askar**: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters - II. Cataclysmic variables - progenitors and population at birth. MNRAS* Vol 464, 4, p.4077-4095 (2017). [ADS Link]
44. **A. Askar**, M. Szkudlarek, D.Gondek-Rosińska, M. Giersz and T. Bulik: *MOCCA-SURVEY Database - I. Coalescing binary black holes originating from globular clusters. MNRAS Letters* Vol. 464, p.L36-L40 (2017). [ADS Link]
45. **A. Askar**, P. Bianchini, R.d. Vita, M. Giersz, A. Hypki and S. Kamann: *MOCCA-SURVEY Database I: Is NGC 6535 a dark star cluster harbouring an IMBH? MNRAS* Vol 464,3, p.3090-3100 (2017). [ADS Link]

46. D. Belloni, M. Giersz, **A. Askar**, N.W.C Leigh and A.Hypki: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters - I. Cataclysmic variables - present-day population.* *MNRAS* Vol. 462, 3, p.2950-2969 (2016). [ADS Link]
47. L. Wang, R. Spurzem, S. Aarseth, M. Giersz, **A. Askar**, P. Berczik, T. Naab, R. Schadow and M. B. N. Kouwenhoven: *The DRAGON simulations: globular cluster evolution with a million stars .MNRAS* Vol. 458, 2, p.1450-1465 (2016). [ADS Link]
48. M. Giersz, N. Leigh, A. Hypki, N. Lützgendorf and **A. Askar**: *MOCCA code for star cluster simulations - IV. A new scenario for intermediate mass black hole formation in globular clusters. MNRAS* Vol. 454, 3, p.3150-3165 (2015). [ADS Link]

Submitted Papers & Preprints

1. M. C. Vergara, **A. Askar**, A. Kamlah, R. Spurzer, F. Flammini Dotti, D. R. G. Schleicher, M. Arca Sedda, A. Hypki, M. Giersz, J. Hurley, P. Berczik, A. Escale, N. Hoyer, N. Neumayer, X. Pang, A. Tanikawa, R. Cen, and T. Naab: *Rapid formation of a very massive star >50000 $M_\odot$ and subsequently an IMBH from runaway collisions. Direct N-body and Monte Carlo simulations of dense star clusters.* (Submitted to A&A 2025). [ADS Link]
2. M. Arca-Sedda, **A. Askar**, and M. Giersz: *MOCCA-SURVEY Database I. Intermediate mass black holes in Milky Way globular clusters and their connection to supermassive black holes.* (2019). [ADS Link]
3. J. Samsing, D. J D'Orazio, **A. Askar** and M. Giersz: *Black Hole Mergers from Globular Clusters Observable by LISA and LIGO: Results from post-Newtonian Binary-Single Scatterings.* (2018). [ADS Link]

Published conference proceedings

1. M. B. Davies, **A. Askar**, R.P. Church: *The Ecology of the Galactic Centre: Nuclear Stellar Clusters and Supermassive Black Holes,* IAU Symposium, Volume 315 (2020). [ADS Link]
2. **A. Askar**, M. Giersz, , M. Arca Sedda, A. Askar, M. Pasquato, A. Leveque *Stellar-Mass Black Holes in Globular Clusters: Dynamical Consequences and Observational Signatures,* IAU Symposium, Volume 315 (2020). [ADS Link]
3. D. Belloni, M. Giersz, L.E. Rivera Sandoval, **A. Askar**, P. Ciecielag: *Are most Cataclysmic Variables in Globular Clusters dynamically formed?,* IAU Symposium, Volume 315 (2020). [ADS Link]
4. M. Giersz, **A. Askar**, L. Wang, A. Hypki, A. Leveque, R. Spurzem: *MOCCA-SURVEY database I. Dissolution of tidally filling star – clusters harbouring black hole subsystems,* IAU Symposium, Volume 315 (2020). [ADS Link]
5. A. Hypki, M. Giersz, **A. Askar**, D. Belloni,A. Leveque: *BEANS – distributed data analysis for numerical simulations,* IAU Symposium, Volume 315 (2020). [ADS Link]
6. M. Giersz, **A. Askar**, J. Klencki, J. Morawski *MOCCA Survey Database I. BHs in star clusters* (Proceedings of the 15th Marcel Grossmann Meeting in Rome (2018). [ADS Link]
7. M. Szkudlarek, D.Gondek-Rosińska, **A. Askar**, T. Bulik, M. Giersz: *Black Hole Binaries from Globular Clusters as Sources of Gravitational Waves* (52nd Rencontres de Moriond on Gravitation (Moriond Gravitation 2017). [iNSPIRE Link]
8. M. Giersz, N. Leigh, A. Hypki, **A. Askar**, N. Lützgendorf: *Formation mechanisms of IMBH in globular clusters* (MmSAI v.87, p.555 2016). [ADS Link]
9. D. Belloni, M. Giersz, **A. Askar**, Hypki: *Cataclysmic variables in globular clusters . First results on the analysis of the MOCCA simulations database* (MmSAI v.87, p.551 2016). [ADS Link]
10. **A. Askar**, M. Giersz, W. Pych, A. Olech, A. Hypki: *MOCCA code for star cluster simulation: comparison with optical observations using COCOA* (IAU Symposium, Volume 312, pp. 262-263 2016). [ADS Link]
11. M. Giersz, N. Leigh, M. Marks, A. Hypki, **A. Askar**: *Monte Carlo modeling of globular star clusters: many primordial binaries and IMBH formation* (IAU Symposium, Volume 312, pp. 213-222 2016). [ADS Link]

Selected Talks/Presentations at International Conferences & Institutes

- Invited talk on *"Formation of Gravitational Wave Sources"* at the 1st ACME workshop on "Gravitational wave sky and complementary observations", Toulouse, France (April 2025)
- Talk on *"Formation of Gravitational Wave Sources Originating From Globular Clusters"* at PAiP, Warsaw, Poland (February 2025)
- Invited talk on *"Formation of Gravitational Wave Sources in Star Clusters"* at TMEX-2025, 21st Rencontres du Vietnam, ICISE, Quy Nhon, Vietnam (January 2025)

- Talk on *"Formation of supermassive black hole in galactic nuclei: LISA binaries & intermediate-mass ratio inspirals"* at MODEST-24: Exploring Dense Stellar Systems Across Cosmic Time, Warsaw, Poland (August 2024)
- Invited Seminar on *"Formation & growth of supermassive black holes: intermediate-mass black holes delivered in stellar clusters & intermediate-mass ratio inspirals"* at SISSA (International School for Advanced Studies), Trieste Italy (May 2024)
- Talk on *"Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered via infalling star clusters"* at Massive Black Holes in the First Billion Years, Kinsale, Cork, Ireland (April/May 2024)
- Talk on *"Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered via infalling stellar clusters"* at MODEST-23: Star Clusters in the Post-Pandemic Era in Northwestern University, Evanston, IL, USA (August/September 2023)
- Invited Review Talk on *"Formation and growth of nuclear star clusters and massive black holes: challenges and lessons from simulations"* at European Astronomical Society (EAS) Annual Meeting (EAS 2023) in Krakow, Poland (July 2023)
- Talk on *"GW190521 and intermediate-mass black holes in star clusters: formation pathways and open questions"* at Niels Bohr International Academy (NBIA) Workshop on Black Hole Dynamics: From Gaseous Environments to Empty Space in Copenhagen, Denmark (May/June 2022)
- Invited Review Talk on *"Dynamical formation of GW190521 in stellar clusters"* at American Physical Society (APS) April Meeting in New York City, USA (April 2022)
- Invited Seminar on *"Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered in stellar clusters"* at Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences in Toruń, Poland (Feb 2022)
- Talk on *"Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered in stellar clusters"* at European Astronomical Society (EAS) Annual Meeting (Leiden, The Netherlands/Virtual Meeting 2021)
- Invited Seminar on *"Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered in stellar clusters"* at International Teeminar, Organized by ARI Heidelberg/Beijing (2021)
- Talk on *"Formation and growth of supermassive black holes in galactic nuclei: LISA binaries & intermediate-mass ratio inspirals"* at 3rd LISA Astrophysics Working Group Meeting (Zurich, Switzerland/Virtual Meeting 2021)
- Invited Seminar Talk on *"Black Hole Dynamics in Star Clusters: Evolution and Growth from Stellar to Supermassive Scales"* at the CENTRA - Center for Astrophysics and Gravitation (Lisbon, Portugal, 2021)
- Talk on *"Formation and Growth of Supermassive Black Holes in Galactic Nuclei: Dynamics of Triple Intermediate-mass Black Holes Delivered in Stellar Clusters"* at the Triple Evolution and Dynamics 3 (TRENDY 3 - Virtual Meeting 2021)
- Invited Seminar on *"Formation of gravitational wave sources in star clusters: From stellar to intermediate-mass black holes"* at University of Birmingham (Birmingham, United Kingdom 2020).
- Invited Talk on *"Dynamical formation of gravitational wave sources"* at XIX Serbian Astronomical Conference (Belgrade, Serbia 2020).
- Talk on *"Formation of supermassive black holes in galactic nuclei: delivering seed intermediate-mass black holes in stellar clusters"* at Galaxy Coffee, Max Planck Institute for Astronomy, MPIA (Heidelberg, Germany 2020).
- Talk on *" Formation of intermediate-mass black holes in dense stellar clusters"* at the 13th International LISA Symposium (Virtual Meeting 2020)
- Invited Review Talk on *" Dynamical Formation of Binary Black Holes in Dense Stellar Environments"* at European Astronomical Society (EAS) Annual Meeting 2020, Symposium 5: *What have we learned from the observed population of gravitational wave sources?* (Leiden, The Netherlands/Virtual Meeting 2020)
- Talk on *"Supermassive Black Hole Formation in Galatic Nuclei: The Role of Intermediate-mass Black Holes"* at Compact Objects For All Meeting at Lund Observatory, Department of Astronomy and Theoretical Physics, Lund University (Lund, Sweden 2020)
- Invited Talk on *"Gravitational Wave Sources Originating in Globular Clusters"* at DKGWEM-2020: Gravitational Wave Science in Denmark, Niels Bohr Institute, Copenhagen University (Copenhagen, Denmark 2020)
- Talk on *"Stellar Mass Black Holes in Globular Clusters: Dynamical Consequences and Observational Signatures"* at Galaxy Coffee, Max Planck Institute for Astronomy, MPIA (Heidelberg, Germany 2019).
- Invited Talk on *"Dynamically Driven Mergers of Black Holes in Dense Stellar Environments"* at Astrophysics with Gravitational Wave Detections Workshop (Warsaw, Poland 2019).
- Talk on *"Why Black Holes Matter in Globular Clusters: Dynamical Consequences and Observational Signatures"* at IAUS 351: Star Clusters: from the Milky Way to the Early Universe and MODEST 19 (Bologna, Italy 2019).

- Talk on "How black holes can influence the evolution of globular clusters" at the MWStreams 2018 conference on "Survival of Dense Star Clusters in the Milky Way System" (Heidelberg, Germany 2018)
- Invited Talk on *"Black Hole Populations in Galactic Globular Clusters"* at the SFB 881 International Workshop on Star "Clusters around the Milky Way and in the Local Group" (Heidelberg, Germany 2018)
- Invited to attended meeting of the "Evolution of Rich Stellar Populations & Black Hole Binaries" International Space Science Institute (ISSI) Team as a core participant and presented a talk on *"Black Hole Subsystems in Galactic Globular Clusters"* at the ISSI (Bern, Switzerland 2018).
- Talk on *"Black Hole Subsystems in Galactic Globular Clusters"* at MODEST 18 (Santorini, Greece 2018).
- Invited Seminar Talk on *"Investigating Black Hole Populations in Globular Clusters with MOCCA Code for Star Cluster Simulations"* at Galileo Galilei Department of Physics and Astronomy, University of Padova/INAF-Astronomical Observatory of Padova (Padova, Italy 2018).
- Invited Seminar Talk on *"Investigating Black Hole Populations in Globular Clusters with MOCCA Code for Star Cluster Simulations"* at Eötvös Loránd University (Budapest, Hungary 2018).
- Talk on *"MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters"* at Numerical Scattering Workshop, Center for Computational Astrophysics, Flatiron Institute, (New York City, USA 2017).
- Talk on *"Gravitational Waves and High Energy Sources Originating From Globular Clusters"* at MODEST 17 (Prague, Czech Republic 2017).
- Invited Seminar Talk on *"MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters"* at Lund Observatory Seminar (Lund, Sweden 2017).
- Seminar Talk on *"MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters"* at Nicolaus Copernicus Center Wednesday Colloqium (Warsaw, Poland 2017).
- Talk on *"Coalescing Binary Black Holes Originating from Globular Clusters"* at Heraeus-Seminar 61: Stellar Aggregates (Bad Honnef, Germany 2016).
- Invited Seminar Talk on *"MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters"* at KIAA/Peking University Lunch Talk (Beijing, China 2016).
- Invited Talk on *"Merging Binary Black Holes Originating from Globular Clusters"* at Astro-GR 2016 Meeting (Benasque, Spain 2016).
- Presented poster on *"Simulating Observations of MOCCA Star Cluster Simulations with COCOA"* at EES 2015 School on Stellar Clusters (Banyuls sur Mer, France 2015).
- Talk on *"Simulating Observations of MOCCA Star Cluster Simulations with COCOA"* at MODEST 15 (Concepcion, Chile 2015).
- Poster presentation, *"MOCCA Code for Star Cluster Simulations: Comparison with Optical Observations using COCOA"* at International Conference of Young Astronomers (Toruń, Poland 2014).
- Talk on *"X-ray Bursts"* at the 5th Serbian Astronomical Student Workshop hosted by University of Belgrade and University of Novi-Sad (Belgrade, Serbia 2011).

Supervision, Mentoring & Teaching Activities

- Supervisor for student project of Jakub Szyndler (currently a masters student in Astronomy at Warsaw Observatory, University of Warsaw, Poland) on *'Observable properties of dense star clusters that host IMBHs'* from May 2025 to July 2025.
- Supervisor for student project of Sohaib Ali (currently a masters student in Physics & Astronomy at Nicolaus Copernicus University in Toruń, Poland) on *'Investigating IMBH Growth and Observational Properties of Star Clusters Hosting IMBHs'* from July 2024 to November 2024.
- **Designed and co-taught (with Mirek Giersz) a PhD level 3 ECTS course with 13 taught lectures and final assessment exercise on "Star Cluster Dynamics and Evolution" for GeoPlanet Doctoral School, Poland (Spring 2024);** [Link to course website and lecture slides]
- Gave a 2 hour lecture on "Black holes in stellar clusters" in the 'ASTM12 - High Energy Astrophysics" masters course at Lund Observatory (Spring 2023)
- Gave a two lecture on "Computational Gravitational Dynamics: Simulating the Evolution of Globular Clusters" in the 'ASTM22 - Computational Astrophysics" masters course at Lund Observatory (Spring 2023).
- Prepared a 30 minute video lecture on "Introduction to Globular Clusters" for the 'Galactic Dynamics VT22" PhD course at Lund Observatory (Spring 2022) and led a 2-hour follow up class on the same topic.
- Gave a 2 hour lecture on "Black holes in stellar clusters" in the 'ASTM12 - High Energy Astrophysics" masters course at Lund Observatory (Spring 2021) and did a 2-hour follow up class with group exercises and discussion.
- Led lecture on "Astrophysical Origin of Gravitational Wave Sources" for the 'Topics on Theoretical Astrophysics"

PhD course at Lund Observatory (Spring 2021)

- Master thesis supervisor of Markus Strickert (Master student at Lund University 2021-2022, currently a PhD student at Leiden University, The Netherlands); [Thesis Link]
- Master thesis supervisor of Lucas Hellström (Master student at Lund University 2019-2020, currently a PhD student at CAMK, Warsaw, Poland); [Thesis Link]
- Bachelor thesis supervisor of Matilda Skantz at Lund University (2023); [Thesis Link]
- Bachelor thesis supervisor of Annie Csomer at Lund University (2022); [Thesis Link]
- Completed course on "Learning and teaching in higher education - theory and practice" for pedagogical training (Lund University, Spring 2020)
- Gave a 2 hour lecture on "Neutron stars, pulsars and compact binaries" for the 'ASTM12 - High Energy Astrophysics" masters course at Lund Observatory (Spring 2019)
- Co-supervised several summer student projects at Nicolaus Copernicus Astronomical Center from 2015 to 2017 (Poland): ▪ Jakub Morawski (2017 Bachelor Student, Warsaw Observatory) ▪ Piotr Kołodziejski (2016 Bachelor Student, Warsaw Observatory), ▪ Jakub Klencki (2016 Master Student, Warsaw Observatory), ▪ Piotr Adamczyk and ▪ Magdalena Szponar (2015 Bachelor Student Warsaw Observatory)
- Co-supervised and assisted with Masters thesis project of Riko Schadow (Ludwig Maximilian University of Munich, 2015) and research project by Arthur Kuehlwein (Heidelberg University, 2015)

Prizes & Awards

- Awarded the competitive SONATA grant for early-career researchers by the Polish National Science Centre (2025–2028)
- POLONEZ BIS fellowship awarded by the European Commission and the Polish National Science Centre (NCN) under the Marie Skłodowska-Curie COFUND action (2023 to 2025)
- **Declined:** Research fellowship from the Swedish National Space Agency (Rymdstyrelsen) (2023 to 2026)
- Awarded Carl Tryggers Postdoctoral Fellowship (2018 to 2020)
- PhD Scholarship in Stellar Dynamics, National Science Center, Poland (2013 to 2017)
- Preludium Grant for PhD Students awarded by the Polish NCN in 2016
- Award for Best Poster at International Conference of Young Astronomers (Toruń, Poland 2014)
- Erasmus Mundus (European Commission) Scholarship for Joint Masters Degree in Astrophysics and Astronomy (2010 to 2012) Total Award: €15,000
- Excellence Scholarship for Undergraduate Studies at University College Utrecht (2006-2009)

Total Award: ∼ € 21,000

- Merit Scholarship for A Levels at University College Lahore (2004-2006)
- Award for Excellence in Computing, University College Lahore (2005)
- Award for Academic Excellence, Bloomfield Hall School (2001)

Funding & Grants

- Principal Investigator (PI) of the SONATA early-career starting grant awarded by the Polish National Science Centre (NCN) (Sept 2025 to Aug 2028), Project Title: *Bridging Observations and Theory: Synthetic Star Cluster Observations from Numerical Simulations* ; Total Funding: ∼€418,000
- Principal Investigator (PI) of the POLONEZ BIS 1 grant co-funded by the European Commission and the Polish NCN under the Marie Skłodowska-Curie COFUND grant (Sept 2023 to Aug 2025), Project Title: *Growth of Black Holes in Stellar clusters*; Total Funding: ∼€214,000
- **Declined:** Principal Investigator (PI) of the Career Grant (2022-C) by the Swedish National Space Agency (Rymdstyrelsen) (2023 to 2026), Project Title: *Growth of black holes in star clusters: Dynamical formation of gravitational wave sources and high-energy transients*; Total Funding: ∼€303,000
- Co-Investigator of the OPUS grant awarded by the Polish National Science Centre (NCN) (2022 to 2025), Project Title: *Compact Objects in Star Clusters as a Laboratory for Multi-Messenger and High Energy Astrophysics* ; Total Funding: ∼€324,000
- Principal Investigator (PI) of the Fysiografen grant awarded by the Royal Physiographic Society of Lund (2019 to 2020); Title: *Evolution of Binaries containing Massive Stars* ; Total Funding: ∼€13,450
- Carl Tryggers Fellowship for postdoctoral research awarded by the Carl Tryggers Foundation for Scientific Research in Sweden (2018 to 2020) Total Funding: ∼€52,500
- PI of the Preludium grant for PhD students awarded by the Polish National Science Center (2016 to 2018)

Title: *Black Hole Binary Zoo in Globular Clusters* Total Funding: ∼€15,750

- PI of the Nicolaus Copernicus Astronomical Center Grant for Young Researchers (2015 to 2017)

Title: *Simulating Mock Observations of Star Cluster Simulations* Total Funding: ∼€3000

Professional Memberships, Service Work and Meeting Organization

- Chair of the scientific organizing committee and member of the local organizing committee for "MODEST-24: Exploring Dense Stellar Systems Across Cosmic Time"conference hosted by the Nicolaus Copernicus Astronomical Center in Warsaw, Poland (19-23 August 2024): [Conference Website]
- Member of the European Astronomical Society (EAS) since 2023
- Junior Member of the International Astronomical Union (IAU) since 2019: [IAU Page]
- Core member of the LISA (Laser Interferometer Space Antenna) consortium and its Astrophysics Working Group (AWG) since 2018
- Expert reviewer for the following journals: Monthly Notices of Royal Astronomical Society (MNRAS), The Astrophysical Journal (ApJ), ApJ Letters, Astronomy & Astrophysics (A&A), A&A Letters, Acta Astronomica
- Organizer and chair for the monthly, 'Topics in Star Cluster Evolution and Dynamics' (TCE)" meeting at Nicolaus Copernicus Astronomical Center (2023 to present)
- Organizer and chair for the weekly 'Stellar Dynamics and Evolution' group meetings at Lund Observatory (2021 to 2023)
- Examination committee member for master and bachelor student exams at Lund Observatory (2019, 2020, 2021)
- Scientific equipment procurement coordinator for Fysiografen grants at Lund Observatory (Fall 2022)
- Member of the local and scientific organizing committees for ELTs for All meeting at Lund Observatory in Sweden (11 to 12 February, 2019)
- Expert reviewer for grant proposals submitted to National Fund for Scientific and Technological Development (FONDECYT) of Chile (2019)
- Member of LOC for Spotkanie Mlodych (Young Astronomers Meeting) at Nicolaus Copernicus Astronomical Center (2014 and 2016)

Outreach Activities: Popular Talks and Public Lectures

- Popular talk on *"Dancing Among the Stars: How Black Holes Merge in Star Clusters"* at 'Spotkania z astronomią' hosted by Nicolaus Copernicus Astronomical Center Warsaw, Poland (2025).
- Supervised a 2 week high school student internship project of Ismena Leśko (from JDJ International Open Schools, Poznan) on numerical investigations of 2-body gravitational encounters with tidal dissipation (September 2024).
- Talk on *"Growing Black Holes in Star Clusters"* at the International Conference for Young Astronomers hosted by the Nicolaus Copernicus Astronomical Center in Warsaw, Poland (2024).
- Talk on *"Merging Black Holes in Dense Star Clusters"* at Space Research School for high school students organized by Astronomisk Ungdom and Lund Observatory, Sweden (2023).
- Supervised high school research project of Amanda Skog, Aron Andrén & Alexander Andersson from Ystad Gymnasium in Sweden working on a project on 3-body gravitational scattering experiments titled, "Merging stellar-mass binary black holes" (Fall 2023/Spring 2024)
- Presented public talk (for high school students) on *"Merging Black Holes in Star Clusters"* at NMT Dagarna at Lund Observatory, Sweden (2023).
- Supervised high school project of Viktor Wellander (Thorén Business School, Örebro, Sweden) on "Determining the Mass of the Supermassive Black Hole in our Galaxy" (Fall 2022) → Semi-finalist of competition for Swedish high school research projects in STEM
- Public talk on *"Merging Black Holes in Star Clusters"* at Kulturnatten (Culture Night) 2022 at Lund Observatory, Sweden (2022).
- Invited popular talk on *"Merging Black Holes in Star Clusters"* at Gastronomilägret summer camp organized by Astronomisk Ungdom, Sweden (2022).
- Presented public talk (for high school students) on *"Merging Black Holes in Star Clusters"* at NMT Dagarna at Lund Observatory, Sweden (2022).
- Presented public talk on *"Simulating Star Clusters: Dynamical Evolution to Merging Black Holes"* at Kulturnatten (Culture Night) 2019 at Lund Observatory, Sweden (2019).
- Presented public talk on *"Cosmic Explosions: From Supernovae to Colliding Black Holes"* at Knut Lundmark-dagarna 2019 at Lund Observatory, Sweden (2019).
- Presented public talk (for high school students) on *"Merging Black Holes in Star Clusters: The New Era of Gravitational Wave Astrophysics"* at NMT Dagarna at Lund Observatory, Sweden (2019).

- Presented public talk on *"Astrophysics of Star Clusters"* at Monthly Meeting of Lahore Astronomical Society (LAST) hosted at Zeds Astronomical Observatory, Lahore, Pakistan (2019).
- Invited Popular Talk on *"Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters"* at Koło Naukowe Astronomów (Student's Astronomy Circle), University of Warsaw Observatory, Poland (2017).
- Presented popular talks on 'Evolution of Star Clusters' at Spotkanie Mlodych (Young Astronomers Meeting), Nicolaus Copernicus Astronomical Center (2014 and 2016).

Scientific Programming and Open Source Tools

Member of the development team of the MOCCA code for star cluster simulations since 2013.

Open Source Development (2016–Present):

- Led the development of the *COCOA* code (written in *Python* & *C*): [Github Page] & [ASCL Entry]
- Contributed by fixing bugs and improving *NBODY6++GPU* code (GPU accelerated direct *N*-body code for collisional stellar dynamics): [Github Page]
- Co-developed an interactive *Jupyter* notebook that uses a supervised machine learning algorithm to use observational properties of a star cluster to predict how many black holes it may contain: [Github Page]

Skills & Miscellaneous

Computer Languages: Proficient in *Python*, *Fortran*, *Shell Scripting*, LaTeX. Fairly decent with *C*.

Data Visualization: Proficient with *gnuplot*, *matplotlib* (and other Python visualization libraries e.g., *seaborn*). Fairly decent with *TikZ*, *matcha*

Software: Proficient with *Mathematica*, *TOPCAT* and experience with *MATLAB*. Very experienced in using popular presentation, word processing and spreadsheet programs. Experienced in using *Git* for tracking software updates.

Graphic Design/Vector Graphics: Fairly decent with *Inkscape* and *GIMP* (Vector Graphics Editors)

Languages: English (Fluent), Urdu (Native), Polish (Beginner Level), Dutch (Beginner Level), Punjabi (Intermediate Level)